Bridging the gap: enabling lower carbon footprint and creating economic value from application of modern high strength niobium steels

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Abstract

This paper presents examples from a bridge and tall-building structure to demonstrate how important it is from the outset that engineers select the correct type of steels (beyond just grade selection), its alloy design and manufacturing route is in bringing about a combination of environmental (savings of >1,000t of CO_2) and economic value (savings of >$100,000s) that is felt throughout the supply chain. It will discuss the advantages niobium micro-alloyed steel systems bring and highlights how to extract maximum contribution from them. Attention is given to the individual and distinct metallurgical role it plays and how judicious additions, only costing a few dollars per tonne of steel, can leverage significant value.

The paper concludes, that in today's market driven environment it is of growing necessity that engineers do take in consideration the advantages that modern niobium micro-alloyed high strength steels can bring through their correct selection at the very start of the design process.

Keywords: high-strength steels; niobium; carbon footprint; value creation; weight-savings.

1 Introduction

Nearly all engineers will have encountered high strength steels (HSS) in some shape or form, and depending on country location will assume it to be steels with a minimum yield strength of approximately 350MPa, or higher. For example, in mainland Europe the most commonly applied grade of steel used in the design of building structures is S355 (minimum yield strength of 355MPa), or equivalent, for hot-rolled structural sections, plate and hollow sections, and this is considered the "norm" and not a high strength steel.

However, in some parts of the world steel grades such as S275 (minimum yield strength of 275MPa), or equivalent, are still widely used and S355 is considered a HSS. This is in part due to local availability of, steel product types, capability of fabricators, experience of structural engineers etc.

In both scenarios, there are on-going efforts within the structural engineering community to use more higher strengths to gain benefits by using less steel (by weight) and/or to meet greater structural requirements (e.g. greater load bearing capability, longer spans etc.). These are indeed positive steps.

After structural analysis, most engineers will select the steel grade based on the Country/Regional Standards and grade designation (e.g. EN 10025:2004 and S355) that meet the required mechanical properties such as yield strength, tensile strength, uniform and total elongation and Charpy V-notch (low temperature impact). However, what is not considered is the alloy design and manufacturing (rolling) route of the product.

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